US Army Corps of Engineers®
Engineer Research and Development Center

Product

FASST (Fast All-season Soil STrength) Model

Technology

The one-dimensional dynamic state-of-the-ground model FASST (Fast All-season Soil STrength) was developed by researchers at the Engineer Research and Development Center's Cold Regions Research and Engineering Laboratory (ERDC-CRREL) as part of the Army's Battlespace Terrain Reasoning and Awareness research program. FASST calculates the ground's moisture and/or ice content, temperature, and freeze/thaw profiles, as well as soil strength and surface ice and snow accumulation/depletion. FASST's fundamental operations are the calculation of an energy and water budget that quantifies both the flow of heat and moisture within the soil and also the exchange of heat and moisture at all interfaces (ground/air or ground/snow; snow/air) using both meteorological and terrain data.

FASST is designed to accommodate a range of users, from those having intricate knowledge of a site to those knowing only the site location. It allows for 22 different terrain materials, including asphalt, concrete, bedrock, permanent snow, and Unified Soil Classification System (USCS) soil types. At a minimum, the only weather information required is air temperature. The code is written in FORTRAN and is publicly available.

Problem

The ability to predict the state of the ground is essential to manned and unmanned vehicle mobility and personnel movement, and to determine sensor performance for military and civilian activities. Trafficability, or ease of travel, is dictated by both soil strength and surface friction, and decreases in the presence of an ice or snow layer or when the top of the ground becomes too wet. Soil strength depends on soil type and on the distribution of water and ice with depth, e.g., the presence of a thawed layer (wet, low bearing capacity) overlying a competent layer of frozen ground has a negative impact on mobility as motion resistance increases and traction decreases. Because infrared and radar sensor performance is determined, in part, by state of the ground, weather-impacted state-of-the-ground conditions resulting in a high degree of clutter can degrade sensor performance.

Expected Cost To Implement

FASST is free to anyone.

Benefits/Savings

FASST is validated, flexible, and easy to use. It is used by military and civilian programs and has been exercised over a range of global latitudes that experience winter conditions. Researchers at Colorado State University have used FASST to investigate soil moisture and snow accumulation/depletion and sensor performance studies carried out at the Naval Postgraduate School, AER (Atmospheric and Environmental Research, Inc.), and ERDC-CRREL. FASST also is included in the military version of ESRI's Arc/Info, Commercial Joint Mapping Tool Kit, and the Army's Digital Topographic Support System.

Status

In its original form, the only effects vegetation had on FASST were to change surface albedo and emmissivity, both of which alter the soil surface energy and moisture budgets. A two-tier, multi-layer vegetation algorithm has been added that can be implemented separately or jointly.

ERDC POC(s)

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Distribution Sources

FASST is available via ftp:

ftp://erdcftp.erdc.usace.army.mil/pub/PERM/FASST/.

FASST documentation is located in the folder “tech_doc” and includes the following:

- How to get FASST.doc (a good place to start; explains what is where and basic file functions)
- fasst_user_document.doc (main FASST user’s documentation)
- SR-04-1.pdf (main technical documentation)
- TR-04-25.pdf (vegetation modules technical documentation)

All files needed to run FASST are located in the folder “models,” which contains these four zip files:

fasst.zip

- fasst.exe (runs FASST)
- read_grout.exe (will pull out data at specific depths from the ground.out output file)
- FORTRAN source code (twenty-two files)
- fasstusersoil.inp (file containing user-specified soil information)
- gr1.inp (sample input file)
- gr1_soil.inp (gr1 specific soil information)
- gr1_met.out (met file needed to run FASST, note same as above)
- fasst.out (met and surface information output file)
- ground.out (node profile information)
- fluxes.out (surface fluxes information)
- vegtemp.out (vegetation temperature information)

weather.zip

- met_reader.exe (runs the met data processor)
- bld_met_mta.exe (use to generate the meta file for your input met file)
- weather.inp (sample input file for met_reader.exe)
- gr1.mta (sample meta file)
- grayling1.met (met file associated with above meta file)
- gr1_met.out (met file generated after running met_reader.exe)
- met_inferred.out (explains how missing parameters are calculated)
- FORTRAN source code (eight files)

make_mta.zip

- bld_met_mta.exe (creates the met data meta file)
- bld_met_mta.f (FORTRAN source code)
- gr1.mta (sample meta file; same as in weather_files.zip)

US_soil_prop.zip

- US_soil_tools.exe (creates a user’s soil properties file such as gr1_soil.inp or fasstusersoil.inp located in fasst_files.zip)
- US_soil_tools.f (FORTRAN source code)

Available Training

Training is not available.

Available Support

If you have technical questions or problems implementing the code, please contact Dr. Susan Frankenstein. If you have difficulty connecting to the ftp site, please contact Linda Gee and copy Dr. Frankenstein.